

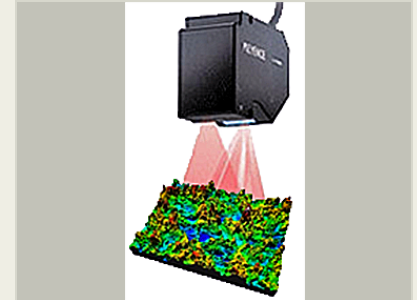
Layer Topographic Mapping (LTM) for L-PBF Process, Phase I

Completed Technology Project (2017 - 2017)



Project Introduction

Metal AM like laser powder bed forming (L-PBF) have low process MRL and part-to-part inconsistencies. In process inspection (IPI) can detect inconsistencies and potential defects on a layer-by-layer basis, offering lower rejections, higher yield, closed loop process control and in process repair. We will develop a novel IPI method called Layer Topographic Mapping (LTM). Surface morphology of every layer is measured after melting to very fine detail at high speed using a COTS laser profilometer (LP) sensor. Dense 3D point clouds (LTMs) of the top layer of the surface are created with high accuracy and spatial resolution. The LTM map describes detailed surface morphology of the layer and also is used to calculate the incremental thickness distribution of the formed layer. The data is analyzed in several ways to detect, classify and locate layer defects such as pores, balling and unfused powder. Both 1D and 2D frequency analysis of the surface profile has been shown effective detecting atypical or aberrant layer topography features that may correspond with flaws. Computer vision tools developed to reliably detect subtle defects in textured surfaces will also be employed, analyzing statistical variation of regions of the image from the overall image. These methods are effective detecting texture abnormalities without any a priori knowledge of the texture itself and are successfully used in high speed industrial inspection applications such as textile production. Flightware has teamed with Edison Welding Institute (EWI) who built and operate a dedicated L-PBF Test Bed to develop effective IPI methods and closed loop process control. This includes several local and area sensors, including a Laser Profilometer mounted on the powder Recoater. EWI's Test Bed is operational today; no SBIR investment is required. In Phase I we will acquire extensive LTM data with the LP sensor and analyze it to detect, classify and locate specific defect conditions in in L-PBF process.



Layer Topographic Mapping (LTM) for L-PBF Process, Phase I Briefing Chart Image

Table of Contents

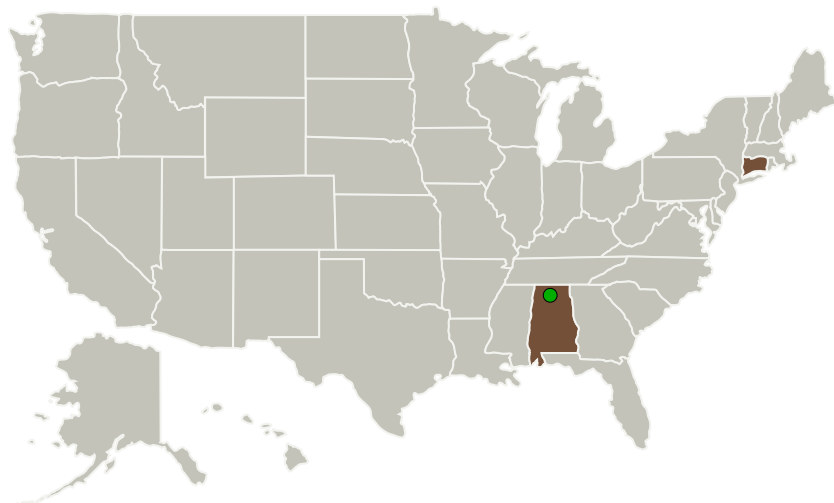
Project Introduction	1
Primary U.S. Work Locations and Key Partners	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	2
Images	3
Technology Areas	3
Target Destinations	3

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Flightware, Inc.	Lead Organization	Industry	Guilford, Connecticut
● Marshall Space Flight Center (MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations

Alabama	Connecticut
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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Flightware, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

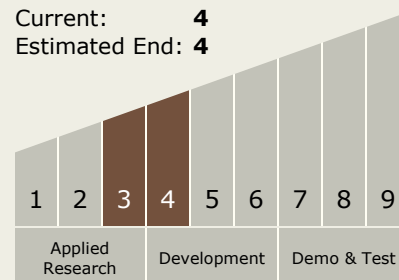
Carlos Torrez

Principal Investigator:

David Maass

Technology Maturity (TRL)

Start: 3
 Current: 4
 Estimated End: 4

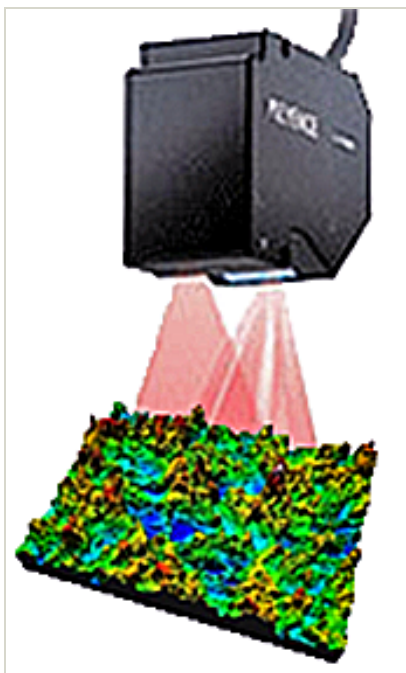


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Images



Briefing Chart Image

Layer Topographic Mapping (LTM)
for L-PBF Process, Phase I Briefing
Chart Image

(<https://techport.nasa.gov/image/132821>)

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
 - └ TX12.2 Structures
 - └ TX12.2.2 Design and Certification Methods

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System